plant *Remirea maritima* and the grass *Stenotaphrum americanum.* Many of the illustrations are limited to the study of a single tree or shrub, indeed all in the parts which deal with monocotyledonous trees and economic plants.

The editors, Drs. G. Karsten and H. Schenck, have provided a very useful and instructive series of plant studies, and it is to be hoped that the publishers will be encouraged to arrange further series. To the botanist and plant lover, as well as to the student, these carefully prepared illustrations should be of very great interest, and will help to make more definite the written descriptions of travellers.

Photographic Failures. Prevention and Cure. By "Scrutator." Pp. 94. (London : Published for the *Photogram* by Dawbarn and Ward, Ltd., 1903.) Price 1s. net.

THE subject of this book will appeal to numerous photographers, for many are the pitfalls which they try to avoid.

Negatives may be too hard or too dense, thin, fogged, unsharp, spotted, curiously marked, &c., and prints may suffer from many similar blemishes.

A book that will inform the photographer of the remedies that may be applied to the particular fault in question is one that should be thoroughly welcomed.

"Scrutator," of the *Photogram*, seems to have supplied this want, and confines his antidotes to the problems which beset the practical photographer. The method of treatment adopted is to describe each failure, fault or defect, then to state the causes to which they are due, and finally to suggest either the preventatives or the remedies to be employed. In the case of negatives he gives some specimen negative prints on thin transparent paper to show how incorrect exposure and development affect the relative tones. The book is one that will be very useful to every photographer.

Up-to-Date Tables for Use throughout the Empire. Weights, Measures, Coinage. Compiled and written by Alfred J. Martin. Pp. 251. (London : T. Fisher Unwin, 1904.) Price 2s. 6d.

THE compiler of this collection of tables believes that the adoption of the metric system of weights and measures for use within the Empire is near at hand, and it is to be hoped his optimism will be justified. He maintains " that if the metric system were made compulsory for railway companies; were adopted by the Bank of England; and shown on our Ordnance Surveys; that within a very short time the system would be generally adopted throughout the Empire." It is unnecessary to do more than mention a few of the numerous tables provided. There are tables showing the relations of various weights and measures of water and of its density at different temperatures; a comparison of British and international systems of physical units, and of measures of time. The little book should certainly serve to popularise the decimal system. A penny supplement for beginners, intended as a guide to simple arithmetic and to show how decimals can be taught at an early age, is also published.

Arithmetical Examples. By W. G. Borchardt, M.A., B.Sc. Pp. viii+279. (London : Rivingtons, 1903.) Price 3s.

THESE examples, with the exception of one paper, are taken from the author's " Arithmetical Types and Examples " recently noticed in these columns. The exercises are numerous and well graded, and in drawing them up Mr. Borchardt has kept the recommendations of the Mathematical Association Committee before him.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Röntgen Rays and the γ Rays from Radium.

IT has been proved by Mr. Strutt that, for the γ rays of radium, the relative conductivity of gases varies approximately as the density, whereas there is a wide divergence from this law in the case of Röntgen rays. Taking air as the standard, the figures given are :—

				Density	γ Rays	Röntgen Rays
Air ...	...	...	...	1·00	1·00	1·00
Carbon dioxide	...	...	1·53	1·53	1·60
Sulphur dioxide	...	...	2·19	2·13	7·97
Chloroform	...	...	4·32	4·88	31·9
Methyl iodide	...	...	5·05	4·80	72·0

Prof. Rutherford suggested some comparative experiments to ascertain if the more penetrating Röntgen rays, after passing through thick metal screens, were similar in their action to the γ rays of radium. The experiments have proved that the relative conductivity imparted to gases by Röntgen rays is a function of the penetrating power of the rays employed, and the results obtained approximate to those found for the γ rays rather than to the high figures previously quoted for Röntgen rays.

In the experiments, two electroscopes were placed side by side, completely enclosed in two thin lead vessels the sides of which were 1·8 mm. thick. A large " hard " bulb and a powerful induction coil were used. The rates of discharge for air were ascertained to be identical, and one of the electroscopes was then filled with gas under examination, and the rates were again measured.

In the case of sulphuretted hydrogen, for which a ratio of six to one has been obtained for ordinary Röntgen rays, the present experiments for penetrating rays showed a close equality with air. This is in agreement with the relative conductivity obtained for the γ rays. Results of a similar character have been obtained for chlorine and for air saturated with chloroform. Further experiments are in progress to compare the relative conductivity of a number of gases for the two kinds of rays.

The results so far obtained indicate that the differences in the relative conductivity of gases, previously observed for Röntgen and γ rays, were due to the great difference in the penetrating power of the rays in the two cases, and that, for Röntgen rays comparable in penetrating power with the γ rays, these differences to a large extent disappear.

A. S. EVE.

McGill University, Montreal, February 18.

Nature of the γ Rays from Radium.

THE interesting results recorded by Mr. Eve in the preceding letter on the relative conductivity of gases for very penetrating Röntgen rays removes the strongest objection that has been urged against the common belief that the γ rays are an extremely penetrating type of Röntgen rays. All the experimental evidence so far obtained is now in agreement with the view that the γ rays are very penetrating Röntgen rays which have their source in the atom of the radio-active substance at the moment of the expulsion of the β or kathodic particle. For example, I have found that the γ rays from radium always accompany the β rays, and are always proportional in amount to them. In radium the β and γ rays appear only in the third change occurring in the radio-active matter which causes " excited activity," *i.e.* in the fourth of the chain of radio-active products which result from the disintegration of the radium atom.

In addition, as Mr. Ashworth pointed out in a recent letter to this Journal (January 28), the fact that the amount of γ rays from radium is independent of its degree of concentration points to the conclusion that the γ rays arise from the disintegrated atom, and are not secondary rays set up by the bombardment of the radium as a whole by the β rays.

On the theory of the nature of Röntgen rays, developed

by the late Sir George Stokes and Prof. J. J. Thomson, it is to be expected that Röntgen rays would be set up at the sudden starting as well as at the sudden stopping of the electron or β particle. As a result of the sudden expulsion of the β particle from radium, it is to be expected that a narrow electromagnetic pulse, i.e. a " hard " or penetrating type of Röntgen rays, would be generated. In addition, on account of the great speed of the β particle, it is able to penetrate through a considerable thickness of matter before it is stopped. A broad pulse or " soft " Röntgen rays should thus arise at the point of incidence of the β rays.

E. RUTHERFORD.

McGill University, Montreal, February 18.

Learned Societies.

My attention has recently been directed to the letters of Messrs. Buchanan and Heaviside, and I quite agree that the existing system of referring papers by learned societies is capable of great improvement. But what I wish to point out is that every author who feels aggrieved has a remedy in his own hands, which consists in abstaining for the future from sending papers for publication to the society against which he has cause of complaint.

A sufficient supply of papers for publication in their *Transactions* or *Proceedings* constitutes the life-blood of the societies to which I refer, and if the supply were cut off these societies would soon die of inanition. At the present day there are a large number of mathematico-physical periodicals, most of which supply authors with a reasonable number of *gratuitous* copies of their paper for private distribution, so that authors gain the same advantages which learned societies offer them, without being subjected to the disadvantage of having their papers referred to a *secret inquisition* composed of persons whom I can testify, from personal experience as a former councillor of a learned society, frequently know far less about the subject-matter of the paper than the author does, and whose reports, to my own personal knowledge, have frequently contained errors from not understanding the papers.

There is absolutely no reason why authors should employ learned societies as the medium for the publication of their papers, and if they have a legitimate cause of complaint against any particular society, the practical and common sense course to pursue is to boycott it. If this were done, it would soon be possible to start a " British Journal of Mathematics and Physics " on the same lines as the American and various other foreign journals, the absence of which constitutes a very serious blot upon British scientific enterprise.

A. B. BASSET.

Grand Hotel, Alassio, Italy, March 3.

A Dynamical System illustrating the Spectrum Lines and the Phenomena of Radio-activity.

IN NATURE of February 25 there appeared a letter by Prof. Nagaoka, of Tokyo, relative to the stability and vibrations of a ring of negative electric charges revolving about a central positive charge. Prof. Nagaoka states that such a system is generally stable, but as the result of an investigation by the method used by Maxwell for Saturn's ring, I came to the conclusion some five years ago that the system is unstable if the law of electric force be that of the inverse square and the magnetic force be neglected. Consequently I thought the result not worth publication, but in view of Prof. Nagaoka's letter it may now be of interest to your readers.

Maxwell (" Collected Papers," vol. i. p. 315) finds the frequency equation for displacements perpendicular to the plane of a ring of revolving satellites to be

$$n'^2 = S + (R/\mu) J,$$

where S is the mass of Saturn, R/μ that of each satellite, and the radius of the ring is unity. The displacements are of the type $\zeta = C \cos (m\theta + n't + \gamma)$, where C, γ are arbitrary constants, θ is the arc from a point of the ring to the satellite, and m is an integer.

If p be the number of satellites and r an integer, we have

$$J = \Sigma \sin^2 m\theta/2 \sin^3 \theta$$

with $\theta = r\pi/p$; the summation is taken for all values of r from 1 to $p - 1/2$ if r be odd, and from r to $p/2$ if p be even, with the coefficient $\frac{1}{4}$ for the last term in place of $\frac{1}{2}$. The disturbance which is most likely to cause instability is that for which $m = p - 1/2$, or $p/2$, as the case may be.

In the electrical problem R/μ is to be replaced by $-e^2/Ma^3$, if e be the charge and M the mass of each electron of the ring of radius a; the minus sign is due to the fact that the electrons repel each other. S is to be replaced by $+qe^2/Ma^3$, if the central positive charge be qe. The frequency equation now is

$$n'^2 = (e^2/Ma^3) (q - J).$$

In the same way the angular velocity ω is given by the equation

$$\omega^2 = (e^2/Ma^3) (q - K),$$

where

$$K = \Sigma 1/2 \sin \theta.$$

Steady motion is possible so long as $q > K$; this motion is stable (for these disturbances) if $q > J$.

All the terms of K and J are positive, and the lower terms, due to charges near the one considered, increase very rapidly as p increases. Ultimately K is of order $p \log p$, and J of order $p^3 \log p$. The first few values are as follows :—

p	2	3	4	5	6	7	8	9	10
J		0·25	0·58	1·16	2·24	5·0	6·4	11·2	13·6	21·2

I find that $K > p$ when $p > 472$ about ; obviously $J > p$ when $p > 7$.

For an electrically neutral system it follows that $p < 8$.

Prof. Nagaoka considers the motion to be quasistable ; let us therefore consider the value of n' when $p = 8$. In this case $K = 2·80$. Thus $\omega^2 = (e^2/ma^3) \times 5·2$, and $n'^2 = -\omega^2 \times 3·2/5·2$, $n' = \sqrt{-1} \omega \times 0·78$. The time in which the disturbance is multiplied $\epsilon^{2\pi}$ times, that is, 535 times, is thus 1·27 × the period of revolution ; this implies a high degree of instability for $p = 8$, and *a fortiori* for $p > 8$.

Let us now consider the radial and tangential disturbances ; let their frequency be $x\omega$. The frequency equation is of the form

$$(x^2 - a)^2 = b - cx,$$

where a is a positive constant, and $b > a^2$; c is smaller than either, and, in fact, vanishes when $m = p/2$. In the Saturn problem b can be made less than a^2 by making the number of satellites small enough, but in the electrical problem this cannot be done.

Since $b = 0$ for $m = p/2$, all arrangements of an even number of electrons in a ring are unstable ; this excludes $p = 2$, 4 and 6.

When $m = (p - 1)/2$, I find for

$p = 3$: 　　$a = 0·44$, 　　$b = 1·23$, 　　$c = 0·24$;
　　5 : 　　　0·55, 　　　3·80, 　　　0·47 ;
　　7 : 　　　0·85, 　　　10·80, 　　　0·66.

The parabolas

$$y = x^2 - a \quad \text{and} \quad y = b - cx$$

in these cases intersect in only two points ; thus two frequencies are imaginary, and the system is unstable.

Of course, the whole investigation assumes symmetrical arrangement of the electrons. When there are three rings the frequency equations involve toroidal functions and are difficult to deal with. The effect of magnetic force has not been taken into account, but I do not see any reason why it should seriously affect the conclusions.

G. A. SCHOTT.

University College of Wales, Aberystwyth, February 29.

P.S.—I am at present examining the case of three or more rings ; the axial motion for three rings can be made stable by taking the radii nearly equal and the electrons of the middle ring of opposite sign to those of the other two ; as to the radial and tangential motions, I am not yet able to express an opinion. Two rings are obviously unstable.

March 7.

The n-Rays.

IN trying to repeat Blondlot's experiments I have met with the usual lack of success, but one experiment I have made seems worthy of record. A small quantity of radium salt was accidentally spilled upon a barium platinocyanide screen, which consequently became faintly luminous in the dark. The light was very faint, and in order to see it more